



## 299-E33-68 (A6876)

### Log Data Report (REVISED)

#### Borehole Information:

|                                     |            |  |                                   |                         |             |
|-------------------------------------|------------|--|-----------------------------------|-------------------------|-------------|
| <b>Borehole:</b> 299-E33-68 (A6876) |            |  | <b>Site:</b> 216-B-8 Crib         |                         |             |
| <b>Coordinates (WA State Plane)</b> |            | <b>GWL<sup>1</sup> (ft):</b> Not reached | <b>GWL Date:</b> n/a <sup>2</sup> |                         |             |
| North                               | East       | <b>Drill Date</b>                        | <b>TOC<sup>3</sup> Elevation</b>  | <b>Total Depth (ft)</b> | <b>Type</b> |
| 137468.527                          | 573781.617 | 12/47                                    | 643.83                            | 150                     | Cable tool  |

#### Casing Information:

| Casing Type    | Stickup (ft) | Outer Diameter (in.) | Inside Diameter (in.) | Thickness (in.) | Top (ft) | Bottom (ft) |
|----------------|--------------|----------------------|-----------------------|-----------------|----------|-------------|
| Steel (welded) | 2.5          | 8.625                | 8.0                   | 0.3125          | 0        | 150         |

#### Borehole Notes:

The casing depth information and drill date provided above are derived from *Hanford Wells* (Chamness and Merz 1993). The approximate casing size information for 8-in. steel casing is confirmed from tape and caliper measurements collected in the field by MACTEC-ERS personnel. Coordinates and TOC elevation are derived from HWIS<sup>4</sup>.

#### Logging Equipment Information:

|  |  |
|--|--|
| <b>Logging System:</b> Gamma 1D          | <b>Type:</b> SGLS (35%)                        |
| <b>Calibration Date:</b> 07/01           | <b>Calibration Reference:</b> GJO-2001-243-TAR |
| <b>Logging Procedure:</b> MAC-HGLP 1.6.5 |  |
| <b>Logging System:</b> Gamma 1C          | <b>Type:</b> HRLS                              |
| <b>Calibration Date:</b> 02/02           | <b>Calibration Reference:</b> GJO-2002-309-TAR |
| <b>Logging Procedure:</b> MAC-HGLP 1.6.5 |  |

#### Spectral Gamma Logging System (SGLS) Log Run Information:

| Log Run           | 1        | 2        | 3        | 4 Repeat |  |
|-------------------|----------|----------|----------|----------|--|
| Date              | 11/16/01 | 11/19/01 | 11/20/01 | 11/20/01 |  |
| Logging Engineer  | Spatz    | Spatz    | Spatz    | Spatz    |  |
| Start Depth (ft)  | 3.0      | 150.0    | 48.5     | 60.5     |  |
| Finish Depth (ft) | 49.5     | 59.0     | 60.0     | 75.0     |  |
| Count Time (sec)  | 100      | 100      | 100      | 100      |  |
| Live/Real         | R        | R        | R        | R        |  |
| Shield (Y/N)      | N        | N        | N        | N        |  |
| MSA Interval (ft) | 0.5      | 0.5      | 0.5      | 0.5      |  |
| ft/min            | n/a      | n/a      | n/a      | n/a      |  |
| Pre-Verification  | A0039CAB | A0040CAB | A0041CAB | A0041CAB |  |
| Start File        | A0039000 | A0040000 | A0041000 | A0041024 |  |
| Finish File       | A0039093 | A0040182 | A0041023 | A0041053 |  |
| Post-Verification | A0039CAA | A0040CAA | A0042CAA | A0042CAA |  |

**High Rate Logging System (HRLS) Log Run Information:**

| Log Run           | 1        | 2        |  |  |  |
|-------------------|----------|----------|--|--|--|
| Date              | 02/28/02 | 03/04/02 |  |  |  |
| Logging Engineer  | Kos      | Kos      |  |  |  |
| Start Depth (ft)  | 28.0     | 38.0     |  |  |  |
| Finish Depth (ft) | 39.0     | 48.0     |  |  |  |
| Count Time (sec)  | 300      | 300      |  |  |  |
| Live/Real         | L        | L        |  |  |  |
| Shield (Y/N)      | N        | N        |  |  |  |
| MSA Interval (ft) | 0.5      | 0.5      |  |  |  |
| ft/min            | n/a      | n/a      |  |  |  |
| Pre-Verification  | D0017CAB | D0018CAB |  |  |  |
| Start File        | D0017000 | D0018000 |  |  |  |
| Finish File       | D0017022 | D0018020 |  |  |  |
| Post-Verification | D0017CAA | D0019CAA |  |  |  |

**Logging Operation Notes:**

SGLS and HRLS logging were performed in this borehole during November 2001 and February 2002, respectively. The reference depth for logging measurements is the top of casing. SGLS log run 2 was conducted with the ground surface as the zero reference point rather than the TOC used for log runs 1, 3, and 4. The depths were adjusted downward 2.5 ft to assure all log runs had a consistent reference point at the top of casing. Thus, the depths of 147.5 to 56.5 ft (log run 2) were adjusted to 150.0 to 59 ft. A repeat section was collected between 60.5 and 75 ft to measure the SGLS performance. The HRLS was utilized to perform logging in high gamma flux zones, generally where SGLS dead time exceeded 40 percent.

**Analysis Notes:**

|                 |         |              |          |                   |                        |
|-----------------|---------|--------------|----------|-------------------|------------------------|
| <b>Analyst:</b> | Henwood | <b>Date:</b> | 03/12/02 | <b>Reference:</b> | MAC-VZCP 1.7.9, Rev. 2 |
|-----------------|---------|--------------|----------|-------------------|------------------------|

This Log Data Report is a revision of the report originally issued 01/15/02. This revision includes high rate data analysis results that were not previously reported and replaces the original Log Data Report.

Pre-run and post-run verifications of the logging system were performed for each day's log event. The efficiency (peak counts per second) of the SGLS was consistently lower each day in the post-run verification as compared to the pre-run verification. Evaluation of the spectra indicates the detector is functioning normally and the log data are provisionally accepted, subject to further review and analysis. The pre- and post-verifications of the HRLS passed acceptance criteria. The post-verification data were applied to spectra for the energy and resolution calibration.

A casing correction for 0.322-in.-thick casing is applied for the nominal 8-in. steel casing. This value is within the error of the field measurement collected to confirm casing size and represents the published thickness for ASTM schedule-40 steel pipe, a common borehole casing at Hanford.

Each spectrum collected during a log run was processed in batch mode using APTEC Supervisor to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL using an efficiency function and corrections for casing and dead time as appropriate. EXCEL templates named G1dJul01.xls and G1cFeb02.xls were used to process the SGLS and HRLS data, respectively. Dead time corrections are applied to log data, including the total gamma data, where the dead time is in excess of 10.5 percent. In zones of high SGLS dead time (> 40%), gross count rates and radionuclide concentrations are not considered reliable, and actual values may be higher than reported. Where dead time is greater than 40 percent, pulse pileup and peak spreading effects tend to result in underestimation of peak count rates. The HRLS is utilized in zones of high SGLS dead times to quantify the <sup>137</sup>Cs concentrations. The <sup>214</sup>Bi peak at

1764 keV was used to determine the naturally occurring  $^{238}\text{U}$  concentrations rather than the  $^{214}\text{Bi}$  peak at 609 keV. The higher energy 1764-keV energy peak exhibits slightly better count rates than the 609-keV peak because of less gamma attenuation caused by the casing in this borehole and because of the interference of the 609-keV peak by the 662-keV  $^{137}\text{Cs}$  peak in higher concentration zones.

### **Log Plot Notes:**

Separate log plots are provided for the man-made radionuclide ( $^{137}\text{Cs}$ ) detected in the borehole, naturally occurring radionuclides ( $^{40}\text{K}$ ,  $^{238}\text{U}$ ,  $^{232}\text{Th}$  [KUT]), a combination of man-made, KUT, total gamma and dead time, a plot of total gamma plotted with dead time, and a repeat section plot. Data collected with the HRLS are plotted with the SGLS data where appropriate to provide a continuous record of  $^{137}\text{Cs}$  concentrations over 0.5-ft depth intervals.

For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, casing corrections, or water corrections. These errors are discussed in the calibration report.

### **Results and Interpretations:**

The only man-made radionuclide detected in this borehole is  $^{137}\text{Cs}$ . A zone of  $^{137}\text{Cs}$  is detected near the ground surface with a maximum concentration of about 200 pCi/g. A second zone of  $^{137}\text{Cs}$  contamination includes the depths from about 29 to 116 ft. SGLS dead times exceeded 40% between 29 and 47 ft, where the calculated concentrations are unreliable and may underestimate the actual concentration. HRLS data have been collected and substituted at these depths. The maximum concentration measured with the HRLS was 35,000 pCi/g at 34 ft.  $^{137}\text{Cs}$  concentrations between 100 and 1,000 pCi/g occur from 47 to 98 ft in depth. From 98 to 116 ft,  $^{137}\text{Cs}$  concentrations decrease from 100 pCi/g to below detectable levels (about 0.3 pCi/g).

Above the high rate zone, apparent  $^{40}\text{K}$  activities are about 12 pCi/g. Within the high rate zone  $^{40}\text{K}$  concentrations increase to about 16 pCi/g, suggesting a transition from the coarse-grained sediments of the Hanford H1 to the finer grained sediments of the Hanford H2.

A repeat log section was collected between 60.5 and 75 ft in depth. The log data show good repeatability for depth and radionuclide concentration.

### **References:**

Chamness, M.A., and J.K. Merz, 1993. *Hanford Wells*, PNL-8800, prepared by Pacific Northwest Laboratory for the U.S. Department of Energy.

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<sup>1</sup> GWL – groundwater level

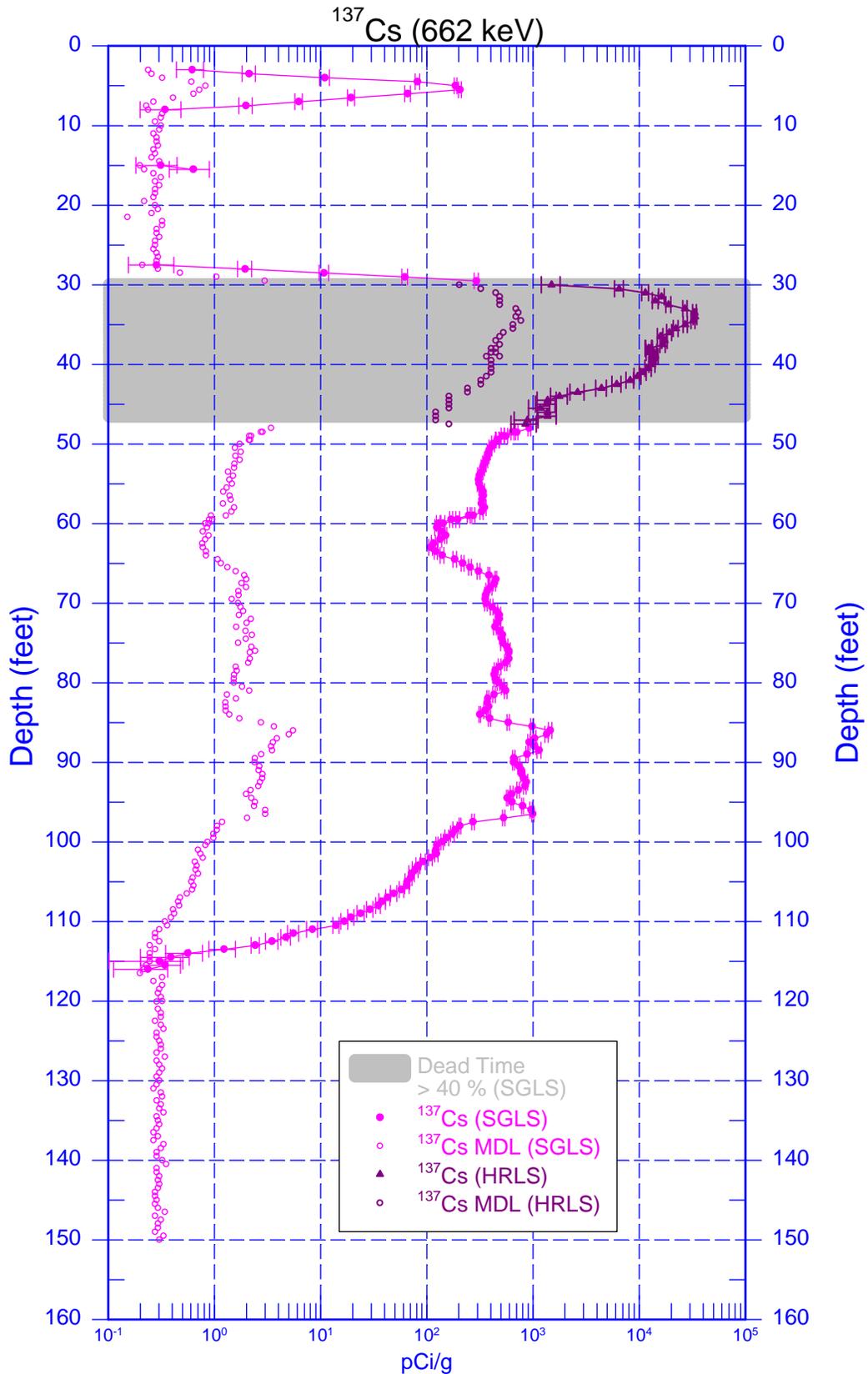
<sup>2</sup> n/a – not applicable

<sup>3</sup> TOC – top of casing

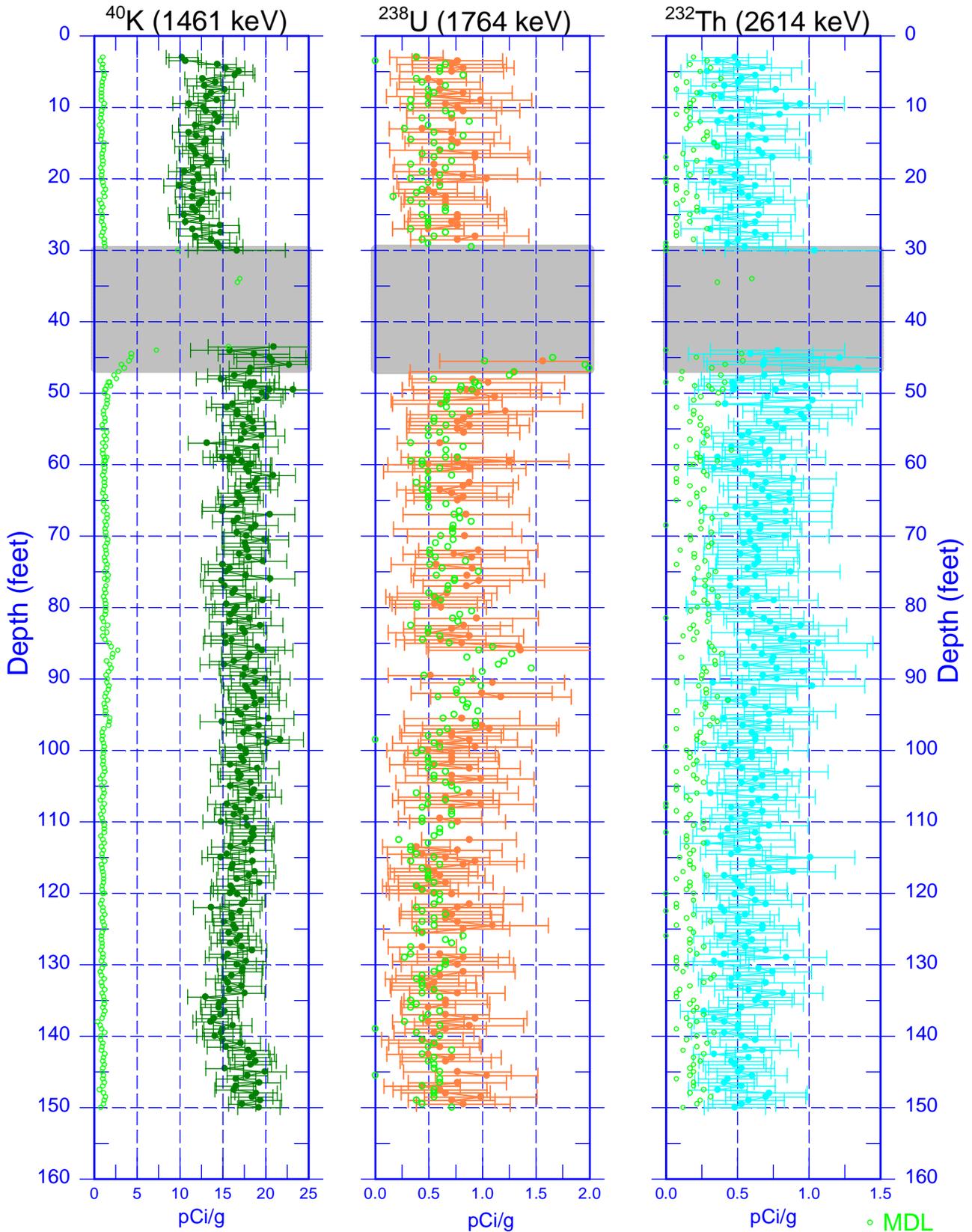
<sup>4</sup> HWIS – Hanford Well Information System

# 299-E33-68 (A6876)

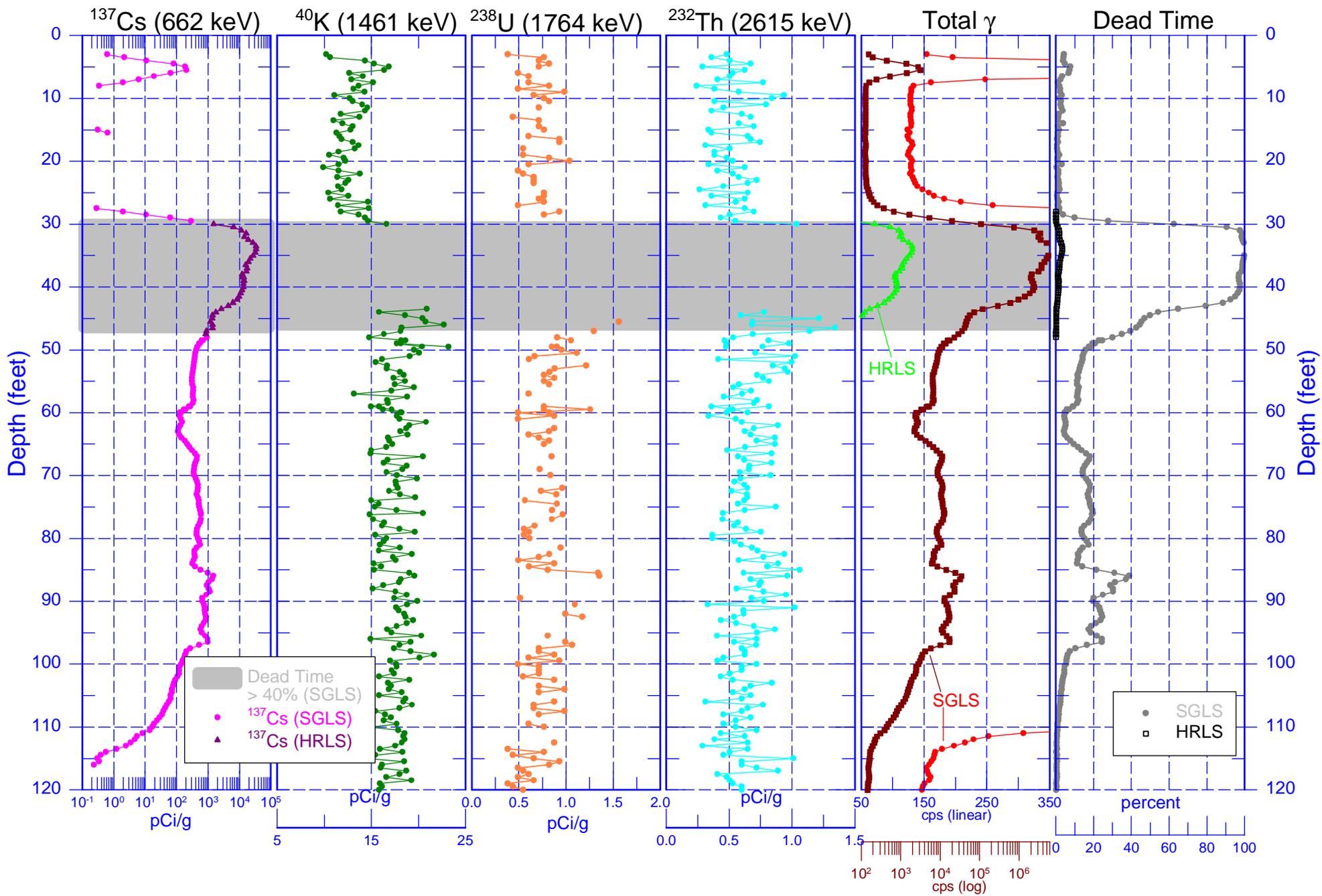
## Man-Made Radionuclide Concentrations



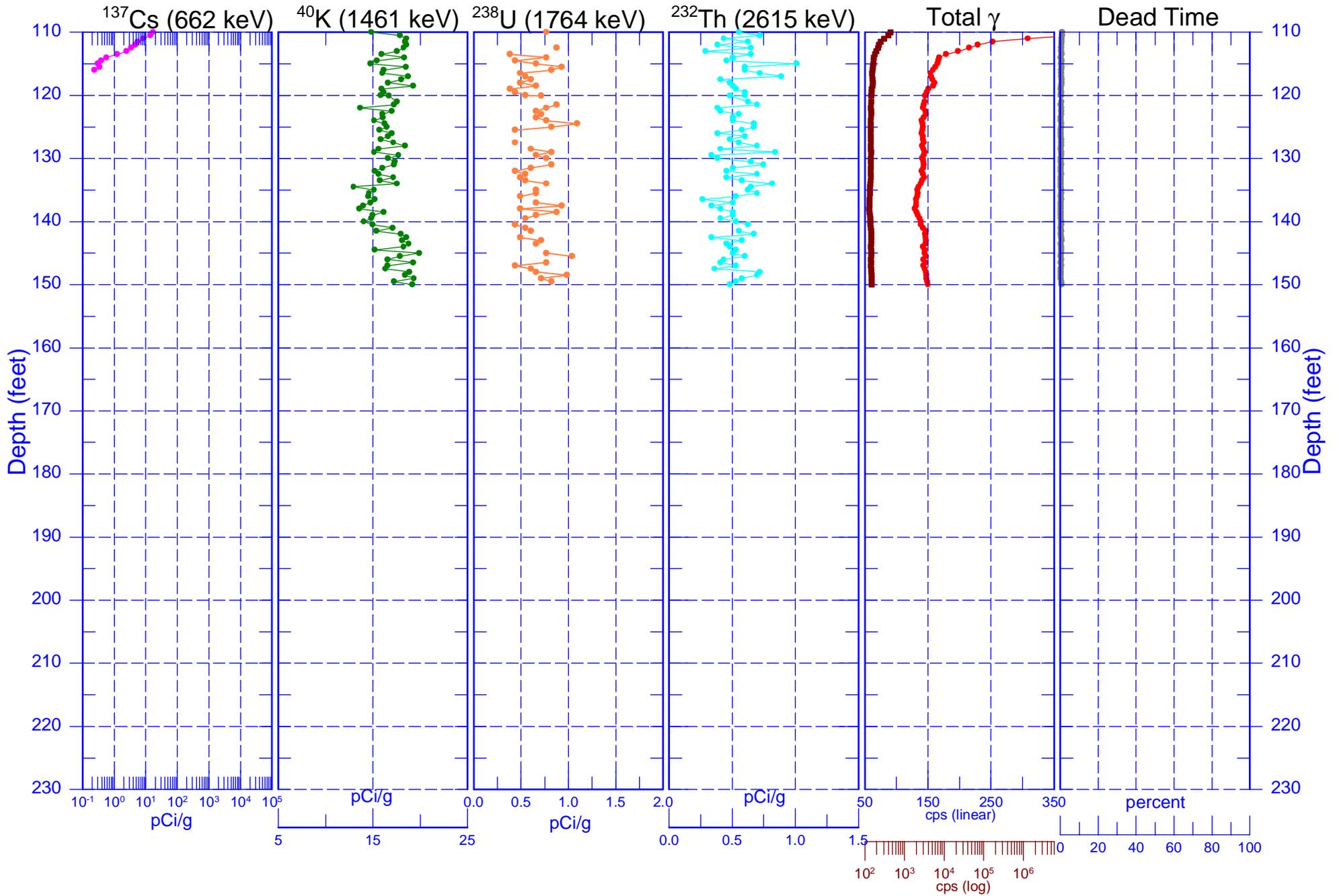
# 299-E33-68 (A6876) Natural Gamma Logs



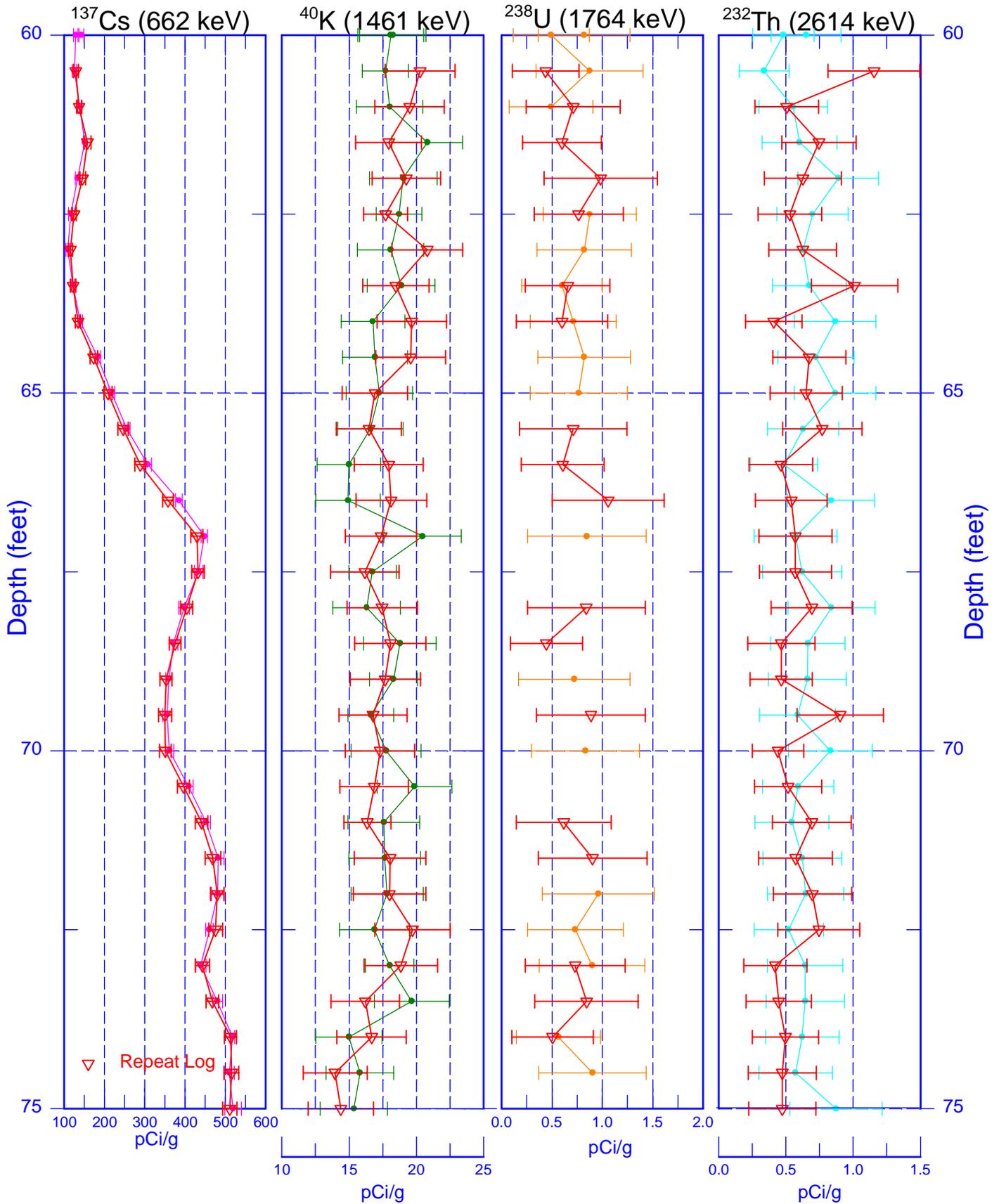
# 299-E33-68 (A6876) Combination Plot



# 299-E33-68 (A6876) Combination Plot (continued)



# 299-E33-68 (A6876) Repeat Logs



# 299-E33-68 (A6876)

## Total Gamma & Dead Time

